OPTICAL REPRODUCING SYSTEM FOR MULTIMEDIA INFORMATION RECORDED WITH CODE DATA HAVING FUNCTION FOR CORRECTING IMAGE READING DISTORTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to an information reproducing system and, more particularly, to an information recording medium such as a paper sheet, which records, as an optically readable code pattern, so-called multimedia information including audio information such as voice data, music data, and the like, video information obtained from a camera, video equipment, and the like, and digital code data obtained from a personal computer, wordprocessor, and the like, and an information reproducing apparatus for reproducing original multimedia information by optically reading a code pattern recorded on such information recording medium.

2. Description of the Related Art

As conventional media for recording voice data, music data, and the like, various kinds of media such as a magnetic tape, an optical disk, and the like are known.

However, these media have relatively high prices even when their copies are mass-produced, and require a wide place for storage.

Furthermore, for example, the need for delivering a medium that records voice data to another person at a remote place requires much labor and time even when the medium is delivered via mail or is directly handed over.

The same problems apply to so-called multimedia information as a whole including video information obtained from a camera, video equipment, and the like, and digital code data obtained from a personal computer, wordprocessor, and the like in addition to audio information.

In view of these problems, the assignee of the present application is assigned U.S. Ser. No. 08/407,018 that relates to a system for recording multimedia information including at least one of audio information, video information, and digital code data on an information recording medium such as a paper sheet in the form of a dot code as image information which allows facsimile transmission and can be copied in a large quantity with low cost, i.e., code information, and an information reproducing system for reproducing the code information recorded on the medium.

The information reproducing system according to U.S. Ser. No. 08/407,018 discloses a reading method in which an information reproducing apparatus for optically reading and reproducing a dot code on an information recording medium is held by a hand, and is manually scanned on the recording medium along the recorded dot code.

Also, U.S. Ser. No. 08/542,220 and U.S. Ser. No. 08/571,776 assigned by the assignee of the present application disclose a method of reading the above-mentioned dot code with high accuracy.

An information reproducing system according to U.S. Ser. No. 08/542,220 and U.S. Ser. No. 08/571,776 disclose the following method. That is, a dot code is constituted by a block consisting of markers, a pattern code, a block address, and user data, and by obtaining a block reference point (marker true center) that minimizes any error relating to the positional relationship between pattern dots in the pattern code and the markers, and the positional relationship of optically read pattern dots, the block reference point can be calculated with high accuracy. Using this block reference point, the reading position of the user data can be calculated with high accuracy.

However, even in the information reproducing system according to U.S. Ser. No. 08/542,220 and U.S. Ser. No. 08/571,776, reading errors occur due to the influences of any skew between the reading portion and the recording surface upon manually scanning the information reproducing apparatus that optically reads the dot code, and of any distortion of the optical system itself, as the recording density of the dot code pattern increases.

The information reproducing apparatus and the information recording medium according to U.S. Ser. No. 08/407,018 do not take sufficient measures against such skew and distortion.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a new and improved information recording system in which information recorded in a code pattern can be reliably reproduced even when a skew occurs between the reading portion and the recording surface due to manual scan or the optical system itself has distortion.

According to the present invention, there is provided an information reproducing apparatus comprising: image pickup means for optically reading, from an information recording medium which comprises a portion that records multimedia information including at least one of audio information, video information, and digital code data in the form of an optically readable code pattern, the code pattern; conversion means for converting the code pattern read by the image pickup means into code data as an image; and reference coordinate calculation means for calculating a reference coordinate position for determining a data reading coordinate position in a block by approximation using an Nth-degree curve passing centers of a plurality of dots arranged at predetermined relative positions on the image upon extraction of the block as a predetermined unit of data from the code data by processing the code data converted by the conversion means.

According to the present invention, there is also provided an information reproducing apparatus comprising: image pickup means for optically reading, from an information recording medium which comprises a portion that records multimedia information including at least one of audio information, video information, and digital code data in the form of an optically readable code pattern, the code pattern; conversion means for converting the code pattern read by the image pickup means into code data as an image; weight addition means for adding weights to a plurality of dots arranged at predetermined positions on the basis of a relative positional relationship between a reference coordinate position for determining a data reading coordinate position in a block and center coordinate positions of the plurality of dots upon extraction of the block as a predetermined unit of data from the code data by processing the code data converted by the conversion means; error evaluation value calculation means for calculating error evaluation values between center coordinate positions of the plurality of dots arranged at the predetermined positions and center coordinate positions of a plurality of dots detected on the image corresponding to the plurality of dots; and reference coordinate calculation means for calculating the reference coordinate position that minimizes the error evaluation values calculated by the error evaluation value calculation means.

According to the present invention, there is also provided an information reproducing apparatus comprising: image